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Pesticides and Honey Bees

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Contents

Recommendations for the Farmer or Applicator 3
Recommendations for the Beekeeper 4
Some Bee Poisoning Symptoms 5
Pesticide-Related Bee Kills and Chemical Analysis 5
Pesticides Grouped According to Their Relative Hazard to Honey Bees 6
Use of Pesticides 10

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Pesticides and Honey Bees[1]

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Honey bees produce honey and beeswax valued at $130 million annually. Much of the honey if foraged from cultivated crops. The annual value of crops benefited by insect pollination, mainly performed by honey bees, exceeds $10 billion. The farmer and the beekeeper are, therefore, dependent upon each other.

Honey bees may be killed when crops are treated with pesticides. When this occurs, both the farmer and the beekeeper suffer a loss. For this reason, they need to cooperate fully in protecting bees from pesticide damage.

By observing the recommendations in this publication, you can greatly reduce bee losses from pesticide poisoning.

Recommendations for the Farmer or Applicator

- Maintain current pest control information. Read pesticide labels and follow approved local, State, and Federal control guides and recommendations. Look for and consider the bee hazards listed. For advice, call your county Extension agricultural agent, Extension entomologist, or apicultural specialist.

- Use Integrated Pest Management (IPM) methods developed for crops in your area if the program results in fewer bee losses. Avoid unnecessary or routine pesticide applications.

- Do not apply pesticides by the calendar. Instead, survey crops for pests. Then, if you must treat, use recommended chemicals.

- Use the proper dosage when chemical control is essential. Use pesticides with the least toxicity to honey bees, or pesticides that have the shortest residual activity.

- Use pesticides having formulations with the least hazard to honey bees. Formulations are rated as follows, from most hazardous to least hazard: 1) dust, 2) wettable powder, 3) flowable, 4) emulsifiable concentrate, soluble powder, or liquid solution, and 5) granules. In some cases, microencapsulated insecticides have been hazardous to bees.

- Apply chemicals when bees are not foraging. Late evening or at night treatment is best because many crop pests are more vulnerable to control measures at these times. Chemicals applied in late evening or night often dissipate by the time bees begin foraging the following morning. Although not as beneficial to bees, early morning application does avoid spraying bees directly. Bees can begin foraging soon after daybreak when temperatures are above 55 to 60°F.

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[1] Trade names are used in this publication solely for the purpose of providing specific information. Mention of a pesticide does not constitute a recommendation for use by the USDA nor does it imply registration under FIFRA as amended.

- Avoid treatments to blooming plants that bees are visiting. Cut cover crops and control weeds before spraying. These plants often attract bees.

- Avoid drift of pesticides onto areas not intended for treatment.

- Do not apply chemicals directly over honey beehives because this kills large numbers of bees and increases the possibility of contaminating hive equipment.

- Do not allow a beekeeper to place hives inside or adjacent to a field scheduled for insecticide application. Pollination is usually as effective with colonies placed a reasonable distance from the field to be pollinated.

- Use ground equipment for applying pesticides where feasible because airplane applications are more likely to drift.

- Know and communicate with beekeepers who have beeyards within 2 miles of fields that you are likely to treat.

Recommendations for the Beekeeper

- Avoid placing apiaries near fields frequently treated with pesticides. Locate beeyards at least 100 yards from fields likely to be treated to avoid directly sprayed colonies. Bee losses decrease as the distance from treated fields increases.

- Post your name, address, and telephone number in a conspicuous place in each apiary.

- Know and maintain communications with farmers within a 2-mile radius of your apiaries. Maintain contact with local pesticide applicators.

- Learn about pesticides, their formulations, and how time of application can affect bee kills. Generally, short residual pesticides are less harmful to honey bees than long residual. A short residual pesticide applied in late evening or at night allows time for the chemical to dissipate before bees begin foraging in the morning.

- The formulation of a pesticide can increase or decrease the hazard to honey bees. Formulations from most to least hazardous are: 1) dust, 2) wettable powder, 3) flowable, 4) emulsifiable concentrate, soluble powder, or liquid solution, and 5) granules. In some cases, microencapsulated insecticides have been hazardous to bees.

- Be prepared to move apiaries from an area when conditions become hazardous for the bees. Planning is important. Locate necessary help, equipment, and a safe alternate location ahead of time. Decide if the move will be temporary or permanent according to the frequency of the hazard. Moves should be made at night to avoid loss of the foraging population.

- Protect small numbers of colonies from pesticides by covering them with wet burlap for one or two days. Cover colonies the night before application when all bees are in the hives, and keep the burlap wet during the entire confinement period. Covering is not practical for large apiaries or when repeated applications of pesticides are made.

- Be able to identify the severity of bee kills caused by pesticides. The bee mortality table of Dr. Carl Johansen of Washington State University gives an indication of relative significance of bee kills per colony.

0 - 100 dead bees/day	(normal die-off)
200 - 400 dead bees/day	(low kill)
500 - 900 dead bees/day	(moderate kill)
1000 or more dead bees/day	(high kill)

Strong colonies are more likely to receive severe damage than weaker colonies because of their larger populations of foraging bees.

- Feeding sugar syrup and pollen cakes to colonies damaged by pesticides will aid in the recovery of the population.

- Be familiar with the value of insect pollination to crops and other plants. By repeating this information to farmers and others, they could be encouraged to protect honey bees.

- Avoid locating beeyards in areas where your bees will become a public nuisance. Provide adequate water near colonies. A good relationship with farmers and others is a valuable asset.

Some Bee Poisoning Symptoms

1. Excessive dead bees at hive entrance.
2. Aggressive bees.
3. Stupefaction and paralysis.
4. Regurgitation.
5. Abnormal communication dances performed on the landing board.
6. Disorganized behavior of poisoned workers causing lack of recogniton by guard bees.
7. Bees "crawl" or move slowly and appear chilled.
8. Dead brood in or in front of the hive.
9. Extreme agitation, and fighting, in the hive caused by poisoned workers.
10. Queen supersedure caused by agitation of workers.
11. Poor egg-laying pattern by queen.

Additional Information

Atkins, E. L. 1975. Injury to honey bees by poisoning (pp. 663-697) *In*: The Hive and the Honey Bee. Dadant and Sons, Hamilton, IL.

Atkins, E. L., D. Kellum, and K. W. Atkins. 1981. Reducing pesticide hazards to honey bees. Univ. Calif. Leaflet 2883. 23pp.

Johansen, C. 1983. How to reduce bee poisoning from pesticides. West. Reg. Ext. Pub. WREP 15. 8pp.

Wilson, W. T., P. E. Sonnet, and A. Stoner. 1980. Pesticides and honey bee mortality (pp. 129-140) *In*: Beekeeping in the United States. USDA Agric. Handbook 335.

Pesticide-Related Bee Kills and Chemical Analysis

Beekeepers who experience pesticide-related bee kills and desire chemical residue analysis of dead bees or hive products should send samples to either a State or private analytical laboratory capable of testing for pesticide residues. If legal action is contemplated, the samples should be taken by a third party. All samples should be placed in clean glass or plastic containers and frozen immediately.

When reporting a bee kill by letter to a State, Federal, or beekeeper organization, include your name, address, zip code, and telephone number with the area code. The letter should contain as much information as possible about the bee kill. Example, include the following information: name, type, and formulation of pesticide, if known; how exposed (direct spray, drift, or field force foraging in treated fields); location of incident; number of bees or colonies killed; and any other pertinent information. All bee kills should be reported.

Pesticides Grouped According to Their Relative Hazard to Honey Bees[2]

(From E.L. Atkins, D. Kellum, and K.W. Atkins. 1981. Reducing pesticide hazards to honey bees. Univ. Calif. Leaflet 2883. 23pp.)

*GROUP I - **HIGHLY TOXIC***

Pesticides

Advantage(R), carbosulfan[2]
aldrin[2]
Ambush(R)[2, 18], permethrin
arsenicals[1, 2]
Avermectin(R)[17]
Azodrin(R)[1, 2], monocrotophos
Baygon(R)[2], propoxur
Baytex(R)[2], fenthion
Bidrin(R)[1, 2], dicrotophos
Bux(R), bufencarb
Cygon(R)[2], dimethoate
Dasanit(R)[5], fensulfothion
DDVP(R)[2], dichlorvos
Dibrom(R)[2,3], naled
Decis(R)[2], deltamethrin
diazinnon[2], Spectracide(R)
dieldrin[1, 2]
Dimecron(R)[2], phosphamidon
Dursban(R)[2], chlorpyrifos
Ekamet(R), etrimfos
EPN[1, 2]
Ethyl Guthion(R), azinphos-ethyl
Famophos(R), famphur
Ficam(R), bendiocarb
Folithion(R), Sumithion(R), fenitrothion
Furadan(R)[2, 5], carbofuran
Gardona(R)[1, 2], stirofos
Guthion(R)[1, 2], azinphos-methyl
heptachlor[1, 2]
Imidan(R)[2], phosmet
Lannate(R)[2], methomyl
Lorsban(R), chlorpyrifos
malathion, Cythion(R)[2,4]
Matacil(R), aminocarb
Mesurol(R), methiocarb
methyl parathion[1, 2, 11, 12]
Monitor(R)[2], Tamaron(R)[2],
  methamidophos
Nemacur(R)[5], fenamiphos
Nudrin(R)[2], methomyl
Orthene(R)[2], acephate
parathion[1, 2]
Pay-Off(R), flucythrinate
Phosdrin(R)[1, 2, 3], mevinphos
Pounce(R)[2, 18], permethrin
Pydrin(R)[2, 19], fenvalerate
resmethrin, Synthrin(R)
Sevin(R)[2], carbaryl
Sumithrin(R), *d*-phenothrin
Supracide(R)[2], methidathion
Temik(R)[1, 2, 5, 7], aldicarb
tepp[1, 2, 3]
Vapona(R)[2], dichlorvos

*GROUP II - **MODERATELY TOXIC***

Insecticides

Abate(R)[2], temephos
Agritox(R), trichloronate
Bolstar(R), sulprophos
Carzol(R)[2], formetanate
  hydrochloride
chlordane[2]
Ciodrin(R), crotoxyphos
Counter(R), terbufos

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[2] The symbol(R) indicates a registered trade name.

Croneton(R), ethiofencarb
Curacron(R), profenofos
DDT[1, 2, 10]
Di-Syston(R)[1, 2, 6, 18], disulfoton
Dyfonate(R), fonofos
  endrin[1, 2]
Korlan(R), ronnel
Larvin(R)[2], thiodicarb
Metasystox-R(R)[2], oxydemeton-methyl
Mocap(R), ethoprop
Perthane(R), ethylan
Pyramat(R)
Sevin(R)4-Oil[2], carbaryl
Sevimol(R)[2], carbaryl
Systox(R)[1, 2, 18], demeton
Thimet(R)[1, 2, 6], phorate
Thiodan(R)[2], endosulfan
Trithion(R)[2], carbophenothion
Vylate(R)[2], oxamyl
Zolone(R), phosalone

GROUP III - ***RELATIVELY NONTOXIC***

Insecticides and Acaracides

Acaraben(R), chlorobenzilate
allethrin, Pynamin(R)
Altosid(R)[17], methoprene
Baam(R), amitraz
Bacillus thuringiensis[17],
  Bactur(R), Bactospeine(R)
  Bakthane(R), Dipel(R)
  Thuricide(R)
Birlane(R), chlorfenvinphos
Comite(R), propargite
cyolite[2], Kryocide(R)
Delnav(R), dioxathion
Dessin(R), dinobuton
Dimilin(R)[17], diflubenzuron
Dylox(R)[2], trichlorfon
ethion
Fundal(R), Galecron(R),
  chlordimeform
Heliothis polyhedrosis virus
Kelthane(R)[1], dicofol
Mavrik(R)[2], fluvalinate
methoxychlor[2], Marlate(R)

Mitac(R), amitraz
Morestan(R), oxythioquinox
Morocide(R), binapacryl
Murvesco(R), fenson
nicotine[2]
Omite(R), propargite
Pentac(R), dienochlor
Pirimor(R)[2], pirimicarb
Plictran(R)[2], cyhexatin
pyrethrum (natural)
rotenone[2]
sabadilla[2]
Sayfos(R), menazon
Sevin(R) SL[2], carbaryl
Sevin(R) XLR[2], carbaryl
Smite(R), sodium azide
Tedion(R), tetradifon
Tetram(R)
Tokuthion(R), prothiophos
Torak(R), dialifor
toxaphene[1, 2]
Zardex(R), cycloprate

Fungicides

Afugan(R)[2], pyrazophos
Arasan(R), thiram
Bayleton(R), triadimefon
Benlate(R), benomyl
Bordeaux mixture[2]
Bravo(R), chlorothalonil
captan[11]
copper oxychloride sulfate
copper 8-quinolinolate
copper sulfate
Cuprex(R), dodine
cupric oxide
cupric hydroxide, Kocide(R)
Delan(R), dithianon
Dessin(R), dinobuton
Difolatan(R), captafol
Dithane(R) D-14, nabam
Dithane(R) M-22, maneb
Dithane(R) M-45, mancozeb
Dithane(R) Z-78, zineb
Du-Ter(R), fentin hydroxide
Dyrene(R), anilazine
ferbam
glyodin

Hinosan(R), edifenphos
Indar(R), butrizol
Karathane(R), dinocap
Lesan(R), fenaminosulf
Morestan(R), oxythioquinox
Morocide(R), binapacryl
Mylone(R), dazomet
Phaltan(R), folpet
Plantvax(R), oxycarboxin
Polyram(R), metiram
Ridomil(R), metalaxyl
Sisthane(R), fenapanil
Smite(R), sodium azide
sulfur[2]
thiram, Thylate
thyfural
Vitavax(R), carboxin
ziram, Zerlate(R)

Herbicides, Defoliants, and Desiccants

AAtrex(R), atrazine
alachlor
Alanap(R), naptalam
Alopex(R), clofop-isobutyl
Amex(R) 820, butralin
Amiben(R), chloramben
amitrole
Ammate(R), AMS
Aquathol K(R), endothall, dipotassium salt
Avenge(R), difenzoquat
Balan(R), benefin
Banvel(R), dicamba
Basagran(R), bentazon
Basalin(R), fluchloralin
Betanal(R), phenmedipham
Betanex(R), desmedipham
Bladex(R), cyanazine
Blazer(R), acifluorfen
butachlor
butam
cacodylic acid
Cambilene(R)[1], 2,3,6,-TBA
Caparol(R), prometryn
Casoron(R), dichlobenil
Chloro IPC(R), chlorpropham
Cotoran(R), fluometuron
2,4-D[1, 2]
DEF(R)[8]
Desiccant L-10(R)[1, 9], arsenic acid
Devrinol(R), napropamide
dichlorprop[1], 2,4-DP
dinoseb[9], dinitrobutylphenol
diquat[8, 9]
Dual(R), metolachlor
endothall, sodium salt, Accelerate(R)
Eptam(R), EPTC
Eradicane(R), EPTC + safener
Evik(R), ametryn
Evital(R), norflurazon
Folex(R)[1, 8], merphos
Garlon(R), triclopyr
Goal(R), oxyfluorfen
Hoelon(R), diclofop-methyl
Hydrothol 191(R), endothall monopotassium salt
Hyvar(R), bromacil
Igran(R), terbutryn
IPC(R), propham
Karmex(R), diuron
Kerb(R), pronamide
Lasso(R), alachlor
Lorox(R), linuron
Maloran(R), chlorbromuron
MCPA[1]
Methar(R)[1], DSMA
Milogard(R), propazine
Modown(R), bifenox
MSMA[1]
Mylone(R), dazomet
Nortron(R), ethofumesate
Paarlan(R), isopropalin
paraquat[1, 9, 20]
Planavin(R), nitralin
Pramitol(R), prometon
Preforan(R), fluorodifen
Princep(R), simazine
Probe(R), methazole
Prowl(R), pendimethalin
Ramrod(R), propachlor
Randox(R), CDAA
Ronstar(R), oxadiazon
Roundup(R), glyphosate
Sancap(R), dipropetryn

Sencor(R), metribuzin
silvex[1], 2,4,5-TP
Sinbar(R), terbacil
Smite(R), sodium azide
Surflan(R), oryzalin
Sutan(R) + , butylate
2,4,5-T[1, 2]
Telvar(R), monuron
Tenoran(R), chloroxuron
TOK(R), nitrofen
Tolban(R), profluralin
Tordon(R), picloram
Treflan(R), trifluralin
Turf Herbicide(R), endothall, disodium salt
Vegadex(R), CDEC
Zorial(R), norflurazon

Nematicides and Miscellaneous

endothall[13]
Exhalt(R)800[14]
gibberellic acid[13]
Mocap(R)[5], ethoprop
Mylone(R)[5], dazomet
N-Serve(R)[15], nitrapyrin
Polaris(R)[16], glyphosine
Smite(R)[5], sodium azide
Sustar(R)[13, 16]

Number-keyed Notes on Pesticide Uses

1. Some State regulations require permits for most uses of these chemicals, also for 2,4-D and 2,4,5-T as herbicides but not as sprays on citrus.

2. Laboratory and field tested mainly on alfalfa, citrus, cotton, ladino clover, milo, and sweet corn; all other chemicals were laboratory tested only.

3. Dibrom(R), Phosdrin(R), and tepp have such short residual activity that they kill only bees contacted at treatment time or shortly thereafter. Usually safe to use when bees are not in flight; not safe to use around colonies.

4. Malathion has been applied on thousands of acres of alfalfa in bloom without serious loss of bees. However, occasional heavy losses have occurred, particularly under high temperature conditions. If applied to alfalfa in bloom, it should be only as a spray, and application should be made during the night or early in the morning when bees are not foraging in the field. Undiluted technical malathion spray (ULV) should not be used around bees.

5. Nematicide.

6. Di-Syston(R) (disulfoton) and other systemic pesticides used as seed treatments have not caused bee losses.

7. Temik(R) (aldicarb), although highly toxic to bees as a contact poison, is used only in granular form, and extensive field usage has not caused bee losses.

8. Defoliant.

9. Desiccant.

10. DDT has been withdrawn from most uses in the United States.

11. Field dosages have caused brood damage.

12. The microencapsulated formulation of methyl parathion, known as Penncap-M(R), is highly toxic to foraging bees, young hive bees, and brood. Overall, it is 13 times more hazardous to honey bees than the EC (emulsifiable concentrate) formulation. Penncap-M(R) is too hazardous to be applied to any area at any time when bees are present in the field or within one mile of the area to be treated.

13. Plant growth regulator.

14. Sticker/extender.

15. Nitrification inhibitor.

16. Chemical ripener.

17. Insect growth regulator.

18. Honey bee repellent.

19. When applied to blooming alfalfa, Pydrin was only slightly toxic when honey bees were not directly sprayed (preliminary results, J. O. Moffett, Stillwater, Oklahoma 74074).

20. Highly toxic when fed or sprayed on honey bee colonies (J. O. Moffett and H. L. Morton. 1975. Am. Bee J. 115: 178-179, 200).

Use of Pesticides

Pesticide use is governed by a Federal Law administred by the Environmental Protection Agency (EPA). This law requires manufacturers to register pesticides, and makes it illegal for people to use them except in accordance with the instructions on the label.

Follow label insturctions carefully

- Apply pesticides uniformly and be sure they come in contact ONLY with plants or areas you intend to treat.

Regulations of pesticides are under constant review by EPA. As new information is developed and evaluated, registrations may be changed or withdrawn. For the latest information on pesticides and how to use them, consult your county Extension agent or the Agricultural Experiment Station in your State.